

WHAT IS CLAIMED IS:

1 1. An optical system operable to transmit an energy flux, comprising:
2 a first substantially spherical lens comprising first and second substantially
3 hemispherical portions joined at an interface, the interface including a partially
4 reflective material on a first substantially planar surface of at least one of the first and
5 second hemispherical portions; and

6 a second lens having a convex surface and a second substantially planar
7 surface;

8 wherein a portion of the second substantially planar surface of the second lens
9 is secured to the first lens to form an optical axis, the first and second lenses being
10 operable to transmit a first portion of the energy flux along the optical axis, and
11 wherein the partially reflective surface is operable to reflect a second portion of the
12 energy flux at an angle to the optical axis.

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14 2. The optical system of claim 1 wherein the optical axis includes a first
15 focal plane tangent to the first lens at a first point, and wherein the partially reflective
16 surface is operable to reflect the second portion of the energy flux to a second focal
17 plane tangent to the first lens at a second point.

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19 3. The optical system of claim 1 wherein the angle to the optical axis is
20 approximately 90 degrees.

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22 4. The optical system of claim 1 wherein the second lens is secured to the
23 first lens with a first bonding material which is substantially transparent.

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25 5. The optical system of claim 4 wherein the first and second portions of
26 the first lens are characterized by a first index of refraction, the second lens is
27 characterized by a second index of refraction, and the first bonding material is
28 characterized by a third index of refraction which is greater than either of the first and
29 second indices of refraction.

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31 6. The optical system of claim 1 wherein the second substantially planar
32 surface of the second lens is in direct contact with the first lens.

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34 7. The optical system of claim 1 wherein the partially reflective material
35 comprises a dichroic coating which separates the energy flux into first and second
36 channels corresponding to the first and second portions of the energy flux.

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38 8. The optical system of claim 7 wherein the energy flux comprises
39 visible light, and the first and second channels correspond to a green channel and a
40 magenta channel.

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42 9. The optical system of claim 7 wherein the energy flux comprises
43 visible light having an attenuated green channel, and the first and second channels
44 correspond to a luminance channel and a magenta channel.

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46 10. The optical system of claim 1 wherein the partially reflective material
47 is characterized by a neutral density such that a ratio of the first and second portions
48 of the energy flux is substantially constant across a spectrum associated with the
49 energy flux.

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51 11. The optical system of claim 10 wherein the first and second portions of
52 the energy flux are substantially equal across the spectrum.

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54 12. The optical system of claim 1 wherein a thickness of the second lens is
55 selected to cause light transmitted by the optical system to focus on a focal plane
56 normal to the optical axis and tangent to the first lens.

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58 13. The optical system of claim 1 wherein a thickness of the second lens is
59 selected to cause a paraxial focal point of light transmitted by the optical system to be
60 positioned proximate a surface of the first lens.

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62 14. The optical system of claim 1 wherein the second lens is substantially
63 hemispherical in shape.

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65 15. The optical system of claim 1 wherein the first and second portions of
66 the first lens are formed of a material selected from the group comprising true glass,
67 quartz, rutile, ruby and fused silica.

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69 16. The optical system of claim 1 wherein the second lens is formed of a
70 material selected from the group comprising true glass, quartz, rutile, ruby and fused
71 silica.

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73 17. The optical system of claim 1 further comprising a first image capture
74 device coupled to the first lens and configured for receiving the first portion of the
75 energy flux, and a second image capture device coupled to the first lens and
76 configured for receiving the second portion of the energy flux.

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78 18. The optical system of claim 17 wherein the first and second image
79 capture devices are in direct contact with the first lens.

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81 19. The optical system of claim 1 wherein the second lens is secured to the
82 first lens with a first bonding material which forms an apodized pupil.

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84 20. The optical system of claim 19 wherein the apodized pupil has
85 different effective apertures for different channels in a spectrum associated with the
86 energy flux.

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88 21. The optical system of claim 20 wherein the energy flux initially
89 comprises visible light, and the apodized pupil has a first effective aperture in a green
90 channel which is narrower than a second effective aperture in a magenta channel.

91
92 22. The optical system of claim 21 wherein the first and second effective
93 apertures result in the first portion of the energy flux having a first component in the
94 green channel which is reduced by half relative to a second component of the first
95 portion of the energy flux in the magenta channel.

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97 23. The optical system of claim 20 further comprising a dye in the bonding
98 material which results in the different effective apertures.

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100 24. The optical system of claim 17 wherein the first image capture device
101 is a monochrome device, and the second image capture device comprises color filters
102 to separate multiple color images.

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104 25. The optical system of claim 24 wherein the first image capture device
105 is operable to capture green image data, and the second image capture device is
106 operable to capture blue and red image data.

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108 26. The optical system of claim 25 wherein ratios among the red, green,
109 and blue image data correspond to a standard Bayer color filter pattern.

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111 27. The optical system of claim 24 wherein the first image capture device
112 is operable to capture luminance image data, and the second image capture device is
113 operable to capture blue and red image data.

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115 28. The optical system of claim 17 further comprising a first spacer
116 disposed between the first lens and the first image capture device which is operable to
117 focus the first portion of the energy flux on the first image capture device, and a
118 second spacer disposed between the first lens and the second image capture device
119 which is operable to focus the second portion of the energy flux on the second image
120 capture device.

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122 29. The optical system of claim 1 wherein the first lens has a first radius
123 and the second lens has a second radius, and wherein the first radius is approximately
124 equal to the second radius.

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126 30. The optical system of claim 1 wherein the first lens has a first diameter
127 and the second lens has a second diameter, and wherein the first diameter is
128 approximately twice the second diameter.

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130 31. An optical system operable to transmit an energy flux, comprising:
131 a first lens having a convex surface and a first substantially planar surface;

132 a second substantially spherical lens secured to the first substantially planar
133 surface of the first lens to form an optical axis, the first and second lenses being
134 operable to transmit a first portion of the energy flux along the optical axis to a first
135 focal plane tangent to the second lens, the second lens comprising first and second
136 substantially hemispherical portions joined at an interface, the interface including a
137 partially reflective material on a second substantially planar surface of at least one of
138 the first and second hemispherical portions, the partially reflective surface being
139 operable to reflect a second portion of the energy flux at an angle to the optical axis to
140 a second focal plane tangent to the second lens, the first and second focal planes being
141 substantially perpendicular to each other;

142 a first image capture device coupled to the second lens at the first focal plane
143 and configured for receiving the first portion of the energy flux; and

144 a second image capture device coupled to the second lens at the second focal
145 plane and configured for receiving the second portion of the energy flux.
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147 32. The optical system of claim 31 wherein the partially reflective material
148 comprises a dichroic coating which separates the energy flux into first and second
149 channels corresponding to the first and second portions of the energy flux.
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151 33. The optical system of claim 32 wherein the energy flux comprises
152 visible light, and the first and second channels correspond to a green channel and a
153 magenta channel.
154

155 34. The optical system of claim 32 wherein the energy flux comprises
156 visible light having an attenuated green channel, and the first and second channels
157 correspond to a luminance channel and a magenta channel.
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159 35. The optical system of claim 31 wherein the partially reflective material
160 is characterized by a neutral density such that a ratio of the first and second portions
161 of the energy flux is substantially constant across a spectrum associated with the
162 energy flux.
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164 36. The optical system of claim 35 wherein the first and second portions of
165 the energy flux are substantially equal across the spectrum.

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167 37. The optical system of claim 31 wherein the first lens is substantially
168 hemispherical in shape.

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170 38. The optical system of claim 31 wherein the first and second portions of
171 the second lens are formed of a material selected from the group comprising true
172 glass, quartz, rutile, ruby and fused silica.

173
174 39. The optical system of claim 31 wherein the first lens is formed of a
175 material selected from the group comprising true glass, quartz, rutile, ruby and fused
176 silica.

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178 40. The optical system of claim 31 wherein the first lens is secured to the
179 second lens with a bonding material which forms an apodized pupil.

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181 41. The optical system of claim 40 wherein the apodized pupil has
182 different effective apertures for different channels in a spectrum associated with the
183 energy flux.

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185 42. The optical system of claim 41 wherein the energy flux initially
186 comprises visible light, and the apodized pupil has a first effective aperture in a green
187 channel which is narrower than a second effective aperture in a magenta channel.

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189 43. The optical system of claim 42 wherein the first and second effective
190 apertures result in the first portion of the energy flux having a first component in the
191 green channel which is reduced by half relative to a second component of the first
192 portion of the energy flux in the magenta channel.

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194 44. The optical system of claim 41 further comprising a dye in the bonding
195 material which results in the different effective apertures.

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197 45. The optical system of claim 31 wherein the first image capture device
198 is a monochrome device, and the second image capture device comprises color filters
199 to separate multiple color images.

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201 46. The optical system of claim 45 wherein the first image capture device
202 is operable to capture green image data, and the second image capture device is
203 operable to capture blue and red image data.

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205 47. The optical system of claim 46 wherein ratios among the red, green,
206 and blue image data correspond to a standard Bayer color filter pattern.

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208 48. The optical system of claim 45 wherein the first image capture device
209 is operable to capture luminance image data, and the second image capture device is
210 operable to capture blue and red image data.

211
212 49. An optical system operable to transmit an energy flux, comprising:
213 a first substantially hemispherical lens having a first substantially planar
214 surface, the first substantially planar surface having a reflective material thereon; and
215 a second lens having a convex surface and a second substantially planar
216 surface;

217 wherein a portion of the second substantially planar surface of the second lens
218 is secured to the first lens to form an optical axis, the first and second lenses being
219 operable to transmit the energy flux along the optical axis, and wherein the reflective
220 surface is operable to reflect at least a portion of the energy flux at an angle to the
221 optical axis.

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223 50. The optical system of claim 49 wherein the reflective surface is
224 operable to reflect the portion of the energy flux to a focal plane tangent to the first
225 lens.

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227 51. The optical system of claim 49 wherein the angle to the optical axis is
228 approximately 90 degrees.

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230 52. The optical system of claim 49 wherein the second lens is secured to
231 the first lens with a first bonding material which is substantially transparent.

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233 53. The optical system of claim 52 wherein the first lens is characterized
234 by a first index of refraction, the second lens is characterized by a second index of
235 refraction, and the first bonding material is characterized by a third index of refraction
236 which is greater than either of the first and second indices of refraction.

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238 54. The optical system of claim 49 wherein the second substantially planar
239 surface of the second lens is in direct contact with the first lens.

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241 55. The optical system of claim 49 wherein the second lens is substantially
242 hemispherical in shape.

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244 56. The optical system of claim 49 wherein the first lens is formed of a
245 material selected from the group comprising true glass, quartz, rutile, ruby and fused
246 silica.

247
248 57. The optical system of claim 49 wherein the second lens is formed of a
249 material selected from the group comprising true glass, quartz, rutile, ruby and fused
250 silica.

251
252 58. The optical system of claim 49 further comprising an image capture
253 device coupled to the first lens and configured for receiving the reflected portion of
254 the energy flux.

255
256 59. The optical system of claim 58 wherein the image capture device is in
257 direct contact with the first lens.

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259 60. The optical system of claim 49 wherein the second lens is secured to
260 the first lens with a first bonding material which forms an apodized pupil.

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262 61. The optical system of claim 60 wherein the apodized pupil has
263 different effective apertures for different channels in a spectrum associated with the
264 energy flux.

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266 62. The optical system of claim 58 wherein the image capture device
267 comprises at least one of a monochrome device and color filters to separate multiple
268 color images.

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270 63. The optical system of claim 58 further comprising a spacer disposed
271 between the first lens and the image capture device which is operable to focus the
272 reflected portion of the energy flux on the image capture device.

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274 64. A camera comprising the optical system of claim 1.

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276 65. A wireless device comprising the camera of claim 64.

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278 66. A camera comprising the optical system of claim 31.

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280 67. A wireless device comprising the camera of claim 66.

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282 68. A camera comprising the optical system of claim 49.

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284 69. A wireless device comprising the camera of claim 68.

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